5. IMPACTS OF COMMERCIAL OPERATION

Following completion of the 3-year demonstration, three scenarios would be reasonably foreseeable: (1) a successful demonstration followed immediately by commercial operation of the facilities at approximately the same production level; (2) an unsuccessful demonstration followed by conversion of the facilities to an integrated gasification combined-cycle power plant; and (3) an unsuccessful demonstration followed by dismantlement of the facilities. ***The following sections discuss the potential environmental consequences of these three scenarios. For*** the first two scenarios, the expected operating life of the facilities ***is assumed to be 50*** years.

5.1 COMMERCIAL OPERATION FOLLOWING DEMONSTRATION

Under the first scenario, the level of ***most*** short-term impacts during commercial operation would not change from those described for the demonstration (Section 4) because the proposed facilities would continue operating 24 hours-per-day with the same operating characteristics. ***There could be differences, however,*** for impacts that accumulate with time (e.***g., resource consumption***, solid waste disposal, ***and buildup of greenhouse gases in the atmosphere). Also, changes in the environmental setting and other changes external to the facilities could result in changes in project impacts.***

5.1.1 Culm Usage

As described in Section 4.1.3.1, anthracite culm availability is more than sufficient for the demonstration period, but the culm reserves controlled by WMPI may not be sufficient to supply the proposed facilities for more than about 15 years. Continued commercial operation might eventually require the use of other fuels. Depending on the fuel, a change in fuel type could result in changes in air emissions, solid wastes, and byproducts. In addition, impacts related to acquiring the fuel, such as mining, beneficiation, and transportation could result. If petroleum coke were to be used as part of a blended feedstock to the gasifier (up to 25%), the expected effectiveness of the facility's gas cleanup system would ensure that air emissions were not significantly affected by the feedstock composition. As a result, air emissions would remain within the permitted levels for criteria pollutants and hazardous air pollutants. Likewise, based on a percentage basis for carbon content, coke and culm would be very similar, and as a result, additional CO_2 ***emissions would not be expected (see Table 2.1.3 and Appendix G).***

5.1.2 Water Supply

Continued progress in reclamation of abandoned mine lands in the watershed, including sealing mine openings, improving surface drainage, and establishing vegetation on barren sites, could reduce the availability of water from the mine pool system by reducing inflow to the mine pools. Sanders & Thomas, Inc. (1975) estimated that more than one-half of the precipitation

falling in mined portions of the Mahanoy Valley watershed entered mine pools, whereas only about one-third of precipitation on undisturbed sites reaches groundwater (Section 3.4). Over the 50-year period, if continuing reclamation in the watershed succeeded in reducing inflows to the Gilberton mine pool, there would be a reduced need to pump water from the mine pool into Mahanoy Creek and an increased likelihood that an alternative water supply source would be needed. Reductions in discharge of mine pool water to Mahanoy Creek would reduce adverse impacts to creek water quality (Section 4.1.4.1). Potential impacts from using an alternative water supply source or from delays in establishing a new water supply are outlined in Section 4.1.4.1; impacts of establishing a new water supply during commercial operations would be the same as described for the demonstration period.

5.1.3 Solid Wastes

As described in Section 4.1.8.2, the coarse slag from gasification would be sold to the extent possible as a byproduct to offsite customers. Any slag not used commercially would be used as fill material for surface mine reclamation. If applicable criteria are met, the fine solids and sludges from treatment of raw water and wastewater would be placed on lands that were previously mined or covered by culm banks (Section 4.1.8.2). Reclamation activities and needs in the vicinity could easily absorb the volume of material that would be generated. However, these materials could possibly require disposal in a commercial landfill (Section 4.1.8.2). Because Pennsylvania Department of Environmental Protection landfill permits provide for an operating life of about 10 years (Section 3.8), no nearby commercial landfills could guarantee capacity to accommodate the facilities' solid wastes throughout the ***50-***year operating lifetime. However, because of the abundant landfill disposal capacity statewide, which exceeds the state's own needs (Section 3.8), Pennsylvania landfills are likely to have sufficient room for solid wastes from the proposed facilities throughout the ***50-***year period.

Commercial sale of elemental sulfur generated by the proposed facilities would continue. However, while sulfur consumption currently exceeds production in the United States, global sulfur production is increasing while global demand is decreasing, and supply already exceeds demand globally (Ober 2002). If this trend continues, marketing sulfur could become difficult in the future, which would result in disposal of some or all of the 13 tons per day generated by the proposed facilities. Elemental sulfur would be a nonhazardous solid waste and would be acceptable for disposal in a commercial landfill (Section 3.8), but treatment or other special handling could be required to prevent generation of acidic leachate that could increase the environmental mobility of contaminants in other disposed wastes. ***Leaching studies on a mixture of elemental sulfur and coal combustion ash found that this combination promotes production of acidic leachate and release of trace metals from the ash, leading to a recommendation to isolate disposed sulfur from other materials in a landfill (Boegly, Francis, and Watson 1986).***

5.1.4 Carbon Dioxide (CO_2) Emissions

Over the 50-year duration of commercial operation, the facilities could release a total of about 114,000,000 tons of CO_2 to the global atmosphere, consisting of about 42,000,000 tons of CO_2 emissions from facility operations and 72,000,000 tons of CO_2 recovered in the Rectisol unit and released through the thermal oxidizer stack. In the long term (following the demonstration phase), the industrial participant may negotiate the sale of the concentrated CO_2 stream for use in other types of industrial or commercial operations. In addition, during the 50-year period it might become feasible to reduce the project's contribution to global climate change by sequestering some of the recovered CO_2 (1,450,000 tons/yr) underground.

Underground storage, or geologic sequestration, of CO_2 is a promising technology [1] being actively investigated and tested nationally and internationally by DOE and other organizations (Davison et al. 2001, IPCC 2005). Most of the research projects being conducted are at a pilot or smaller scale. Large-scale commercial deployment of the most promising carbon sequestration technologies is expected to be technically practicable within the next 15 years (CO_2 Capture and Storage Working Group 2002). During the 50-year duration of commercial operation, a combination of economic incentives and new legal requirements might result in the industrial participant investigating the option to sequester CO_2 recovered from the proposed facilities.

The feasibility of any potential sequestration technology requires the availability of a suitable geologic setting. Based on geologic factors, there are two theoretically possible scenarios for future geologic sequestration of CO_2 from the proposed facilities: (1) sequestration at a regional sequestration site and (2) sequestration in the Schuylkill County area.

In the first scenario, regional sequestration could occur in Western Pennsylvania, where the Midwest Regional Carbon Sequestration Partnership has identified a potential for geologic sequestration of 76 gigatonnes (83 billion tons) of CO_2 in saline formations, depleted oil and gas fields, and coal seams (Battelle 2005). The region's sequestration capacity would be more than sufficient for the 72,000,000 tons of CO_2 that would be recovered during the facilities' 50-year operating life. A buried pipeline (similar to a natural gas pipeline) or extensive rail transportation (about 14,500 100-ton or 10,360 140-ton rail tanker cars per year) would be required to transport the CO_2 to an injection site in Western Pennsylvania (150 miles or more from Gilberton). Multiple injection wells would need to be installed and operated to receive the CO_2; multiple extraction wells

[1] Potential geologic sequestration technologies include injection into depleted oil and gas fields (to enhance recovery of residual hydrocarbons in addition to trapping CO_2); injection into deep saline formations (in which CO_2 is trapped physically and also reacts chemically with dissolved substances in ground water, precipitating to form solid compounds that remain in the formation); and injection into unmineable coal seams (in which adsorption of CO_2 onto the coal displaces trapped methane, which can be extracted for sale as natural gas). The basic technologies for sequestration are similar to proven technologies routinely used in the petroleum and natural gas industries for purposes such as enhanced oil recovery, underground storage of natural gas, and production of coal-bed methane for sale as natural gas.

also would be needed for CO_2 sequestration in depleted oil and gas fields or methane-bearing coal beds.

In the second scenario, sequestration could occur in the Schuylkill County area, in deep unmineable coal seams, while producing coal bed methane for sale as natural gas. While Midwest Regional Carbon Sequestration Partnership geologic mapping did not extend into Eastern Pennsylvania (Gupta 2006), analyses of the region's geology, geologic history, geologic structure, mining history, and measurements on coal samples suggest a considerable potential to recover methane from unmineable coals in the anthracite region (Milici 2004a and 2004b, Milici and Hatch 2004). DOE estimates[2] that a local carbon sequestration and coal bed methane production operation could sequester only a portion of the facilities' concentrated CO_2 stream, as the potential sequestration capacity in Schuylkill County could not accommodate the facilities' lifetime CO_2 production (72,000,000 tons).

Under either scenario, carbon sequestration operations could have environmental impacts from the use and disturbance of land (for exploration activities, well fields, and CO_2 pipelines) and possibly from rail or truck transportation of CO_2. Any oil or gas production associated with CO_2 sequestration would produce local economic benefits along with potential environmental impacts from refining, storing, and transporting the hydrocarbon fuels. In addition, sequestration combined with coal bed methane recovery could result in impacts from the pumping and disposing of water from the methane-bearing coal beds. In extracting coal bed methane, water is pumped from the coal beds to lower the pressure that keeps methane adsorbed to the surface of the coal, thus stimulating desorption of methane (USGS 2000). In the anthracite region, unmineable coal

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2 ***The presence of methane in the area's coal is indicated by measurements on coal samples and by a history of "fire-damp" (methane) explosions in anthracite mines during the early years of mining (Milici 2004b). While the anthracite region's complex geologic structure would inhibit coal bed methane recovery, the U.S. Geological Survey has identified several areas in the Southern Anthracite Field (i.e., central Schuylkill County) where coal bed methane recovery might be feasible because rock strata are subhorizontal to gently inclined. Total coal bed thicknesses of 50 to 100 ft within the interval about 500 to 2,000 ft below the ground surface (Milici 2004a and 2004b) and in-place gas content expected to average around 300 ft^3/ton may support future development of a commercially viable natural gas production operation, particularly if angled drill holes are used (Milici 2006).***

To estimate potential sequestration capacity in Schuylkill County, DOE assumed the coal has an average gas-in-place methane content of 100 ft^3/ton (USGS data suggest that this is a conservative estimate); the density of CO_2 gas is 17,250 ft^3/ton; 90% of the methane contained in the coal could be extracted and replaced by CO_2 and the volume of CO_2 sequestered would be twice the volume of methane extracted (Battelle 2005). Based on these assumptions, if one year's production of CO_2 from the proposed facilities (1,450,000 tons/year, or about 25 billion ft^3/year as gas) were injected, the injected material would utilize the CO_2 storage capacity of about 140,000,000 tons of in-place coal, while producing about 12.5 billion ft^3/year (about 34,000,000 ft^3/day) of natural gas (methane). Assuming that anthracite coal has a density of 1,500 kg/m^3 (93 lb/ft^3) and the average total thickness of suitable coal is 50 ft, sequestration of one year's CO_2 production would utilize the coal under 1,380 acres.

To sequester the entire 72,000,000 tons of CO_2 generated over the proposed facilities' 50-year operating life would require 6.9 billion tons of in-place coal, which exceeds the total unrecoverable coal reserve in Schuylkill County (Section 3.3.3).

and surrounding rock layers are likely to contain abundant groundwater, which would contribute to the potential for impacts (Milici 2004b).

5.2 CONVERSION TO INTEGRATED GASIFICATION COMBINED-CYCLE PLANT AFTER UNSUCCESSFUL DEMONSTRATION

The types of impacts associated with the second scenario (an unsuccessful demonstration followed by conversion of the facilities to an integrated gasification combined-cycle power plant) would be similar to those in the first scenario for the proposed facilities, but at a somewhat reduced level. The F-T synthesis technology would no longer be required, and equipment associated with this technology, including storage tanks for liquid fuels, would likely be dismantled and removed from the site, which would result in minor impacts (e.g., fugitive dust and emissions from engines during dismantlement and offsite transport of unneeded equipment, additional traffic associated with hauling the equipment off the site). A temporary period of time would exist with negligible operational impacts because the facilities would not be operating during the conversion. Because no liquid fuels would be generated, impacts associated with production and transport of the fuels would not occur. Generation of electricity could be maximized by attempting to upgrade the capacity of the gas turbine and steam turbine. Otherwise, less feedstock and flux would be required to power the turbines without the concurrent production of liquid fuels. Correspondingly, slightly smaller amounts of discharges and wastes would be generated, and reclamation activities would be conducted at a slightly lower rate.

5.3 FACILITIES DISMANTLED AFTER UNSUCCESSFUL DEMONSTRATION

Impacts associated with the third scenario (an unsuccessful demonstration followed by dismantlement of the facilities), would be greatly reduced because the facilities would no longer operate. Minor impacts would result from dismantling and removing the equipment associated with the proposed facilities (e.g., fugitive dust and emissions from engines during dismantlement and offsite transport of plant equipment, temporary traffic associated with hauling the equipment off the site). Following dismantlement and removal, the impacts would become negligible. No electricity, steam, or liquid fuels would be produced. No resources would be required and no discharges or wastes would occur. No anthracite culm would be removed from piles in the local area as feedstock for the proposed facilities, and no associated reclamation of these lands would occur.